

SEASONAL AND CLIMATIC VARIATION IN CERODONTA.

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Cerodonta dorsalis is a small fly of the family Agromyzidæ (sens. str.), the larva of which mines in the leaves and leaf-sheaths of wheat, timothy, etc. It is very widespread in the United States and Canada.

It was described by Loew (a) in 1863, the type being a female from the District of Columbia. He referred it to the genus *Odontocera* Macquart (b), a preoccupied name, for which Rondani (c) had proposed to substitute *Cerodonta*, and a year later Schiner (d) had proposed *Ceratomyza*.

In September, 1913, Melander (e) restored Rondani's overlooked generic name[‡] and separated his North American material into two species on color characters; one he called *dorsalis* Loew, represented from Massachusetts, Louisiana, Illinois, and Texas; the other he identified with the European species *femoralis* Meigen, represented from Montana, Wyoming, Idaho, Washington, British Columbia, Oregon, and California. The latter species he compared with European specimens determined by Strobl.

A few days later, about Oct. 1, 1913, Malloch (f) published his large revision of *Agromyza* and also took up this genus *Cerodonta* (he used the original but evidently erroneous spelling *Cerodontha*). He recognized but one North American species, *dorsalis*, not considering the variations in color to be of specific importance. The National Museum material, with which he was working, was from eighteen States, Atlantic and Pacific among them, and also from Mexico and Porto Rico. Neither Melander nor Malloch knew until about the time of publication that the other was working upon the group, and the two conclusions were arrived at independently.

When I began in 1913 to do some biological work on the group, the difference of opinion between two prominent dipterists as to the species limits presented itself as a problem to

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‡Mr. Malloch has called my attention to an earlier use of *Ceradonta* by Collin, Ent. Mo. Mag., Nov. 1911, p. 254.

be solved. I found I had about fifty specimens from the Rocky Mountains and points west of them, all of general dark color and agreeing with *femoralis* as identified by Melander; I also had about an equal number from localities east of the Rockies, all of paler color and undoubtedly *dorsalis*. This led me to conclude provisionally that Malloch had not given sufficient weight to the geographical segregation of the two forms, and that they were probably distinct species.

The color difference is most conspicuous in the pleuræ, which are almost wholly yellow in eastern material, and blackish with paler sutures in the western; the dorsum, tibiæ, frontal orbits, etc., share in varying degrees in the lighter or darker coloration.

My observations in Indiana in 1914 seemed to confirm my opinion that the western dark form is a distinct species, as I found no such coloration in Indiana specimens, of which I examined a large number.

In 1915 I began to make systematic sweepings on grass and grain and tabulate the flies collected. In this I secured the assistance of several entomologists who swept for me in regions that I could not personally visit.* This brought into my hands a large amount of material in Cerodonta (1876 specimens in the season). During most of the season these ran as expected, dark from the Rockies westward, pale from east of that region. Sweepings from Fort Collins, Colo., August 17, showed for the first time in my experience light and dark forms intermingled; but this place is just on the dividing line, where overlapping might be expected. Sweepings from Great Falls, Mont., September 23, showed the dark form some distance east of the mountains for the first time. On October 9th it turn up at Treesbank, Man., where I had had the pale form earlier in the season. On October 19th dark and intermediate forms were swept at Elk Point, S. D., where light specimens had been abundant earlier; and by this time I was noticing that specimens swept at Lafayette were becoming progressively darker. I continued my sweepings here as late as possible, and on Nov. 27th secured two specimens as dark as any from the west. Specimens from Atherton, Mo., Nov. 6th, were in part

*I wish especially to acknowledge important and continued co-operation from Messrs. Norman Criddle, Treesbank, Man.; C. N. Ainslie, then at Elk Point, S. D.; and Dr. C. F. Adams, Atherton, Mo.

dark also. So it seemed completely demonstrated that in late fall the eastern specimens may become as dark as the western—undoubted lineal descendants of the pale midsummer broods, among which dark forms never occur.

In the summer of 1916 I continued sweeping more actively than before, but not very late in the fall. The only additional observations of any significance on this matter were the collection of one somewhat dark specimen at Aberdeen, S. D., on May 29th, and of several dark ones mixed with a much larger number of light ones at Sioux City, Ia., on May 23d and 26th (Ainslie). This showed that the first spring brood is also affected by the tendency of cold to produce dark colors. The total number of specimens examined in the season was 513, although the number of sweepings was much larger than in the preceding year, indicating that the species was much less abundant in 1916. Except as noted already, all Indiana specimens were decidedly of the pale form, except a single one taken May 10, 1915, which was intermediate.

In 1916 I received from T. D. Urbahns, then located at Pasadena, two pale specimens taken at Yuma, Ariz., which were the first of this form that I had ever seen from the region in or beyond the Rockies.

In the summer of 1917 I was enabled to extend my observations into the Southwest in June, making stops for collection at Marfa, Texas; Las Cruces, N. M.; Tucson, Tempe and Yuma, Ariz. Sweepings at all of these places gave the pale form only, and the prevailing temperature seemed an ample explanation of the phenomenon. Continuing my trip, I collected at San Diego, Cal., in late June, and in July at Santa Barbara, Berkeley, Palo Alto, Martinez, and Fallen Leaf, in California; in Utah at Salt Lake City and in Emigration Canyon at an elevation of 7000 feet; and in Colorado at Tennessee Pass, elevation 10,290 feet. At all of these places I collected only the dark form, and it was abundant wherever fresh grass occurred.

Evidently *dorsalis* is no more than a pale variety of *femoralis*; but when we turn to the European literature we find a whole series of names that have been proposed on color characters that are mostly the same as the ones just discussed in our species. Hence there is some doubt as to whether *femoralis* is not itself a variety of *denticornis*, an older name; and also as to

whether *dorsalis* is not antedated by a European name for the same form. These questions will evidently have to be left to European dipterists.

The color variations described fall in the same class as a number that have been studied in Lepidoptera (for instance see a series of articles by Standfuss in *The Entomologist*, XXVIII, 1895, and a translation of Weismann's experiments in the same journal the following year by W. E. Nicholson), in which low temperature during the pupal period causes the colors to be darker. This may normally affect one brood of a double-brooded species, or it may be climatic rather than seasonal, affecting all the individuals living in the colder region. Even the absence of the pale form of *Cerodonta* in the west in mid-summer accords with butterfly experiments, in which the pale form can be made dark by cold, but the dark form cannot be made pale by heat, indicating that the dark is the primitive type, the pale a comparatively recent modification.

While the subject has not been systematically studied except in Lepidoptera, some observations in other orders agree well; for instance, Horn (g) says of the Clerid beetle *Trichodes ornatus*. "As a rule, the hotter the climate in which the specimens were native, the greater the extent of the yellow color. . . . In colder, and especially damper climates, the blue color predominates."

REFERENCES.

- (a) Loew, *Centuries*, ii, 98, 1863.
- (b) Macquart, *Hist. Nat. Dipt.*, ii, 615, 1835.
- (c) Rondani, *Dipt. Ital. Prod.* iv, 10, 1861.
- (d) Schiner, *Wien. Ent. Monatsch.*, vi, 434, 1862.
- (e) Melander, *Jour. N. Y. Ent. Soc.*, xxi, 249, 1913.
- (f) Malloch, *Annals Ent. Soc. Amer.*, vi, 331, 1913.
- (g) Horn, *Ent. News*, ii, 7, 1891.